

# Mathematics

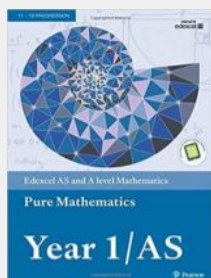
## Transition Booklet

Year 11 to Year 12

A-Level Mathematics is a sought-after qualification and is required to access many prestigious university courses. Mathematics is also a stimulating and rewarding subject to study in its own right.

A Level Maths is NOT an easy option – it does require a lot of self- motivation, determination and self-study. We recommend that you do a minimum of 5 hours work outside the classroom each week. You will need to enjoy a challenge and be willing to accept that a question has ‘gone wrong’ – and be prepared to have another attempt (and another and maybe even another).

During the two years, you study a mixture of pure mathematics, statistics and mechanics. You will sit final exams at the end of Year 13, covering material you will have studied over both Years 12 and 13.



### Textbooks

Teaching of the course is supported with 4 textbooks. You will be given access to online versions of these.

In addition, you will be given a revision guide which will help with your independent study as well as preparation for assessments and exams.



### Calculator

Students will need new calculators for A-level. The minimum standard for this is an advanced scientific calculator, such as the Casio FX-991EX ClassWiz. Graphical calculators such as the Casio FX-CG50 however, have the additional advantage of being able to plot the graphs of functions.



### Folders

You will need to buy at least two A4 Lever arch ring binder folders to carry you through the two year course – one for Pure maths and one for Applied maths. These are available from any stationary store and it is important they are kept in a presentable order for your own revision. In September, you will be given a folder checklist so that you know what to keep in your folder.

### **A Level Mathematics Course**

We use the Pearson Edexcel A-level Mathematics specification. Mathematics has three compulsory examination papers at the end of two years and the content in year 2 builds on and extends the work that has taken place in year 1.

We effectively teach the AS specification in Year 12 and use AS assessments during that year.

In Year 13 we complete the A level specification and use A level assessments. Please bear in mind that in the final examinations there are a mixture of AS Level and A Level content questions.

### **Mathematics Support Available in Cardinal Wiseman Sixth Form**

If you feel you are struggling or you need to talk/discuss anything to do with the course or its teachers please feel free to speak to the members of the department. There will also be weekly drop-in / revision sessions that all A Level Mathematics students are welcome to attend.

The top three tips to succeed are:

1. Attendance is important - if you miss a lesson, the next lesson will seem so much more difficult.
2. Catch-up with any work missed if you do miss a lesson BEFORE the next lesson where possible.
3. There are many online resources including videos available, so use these regularly.

### **A Level Mathematics and Further Mathematics Summer Tasks**

1. Have all equipment listed on the first page ready.
2. Complete the Summer Work exercises from this booklet. These are not optional and you should keep your solutions in your folder.
3. Answer the **Year 12 AS/A Level Maths Baseline Test** at the back of the booklet on paper and bring this with you to the first lesson.
4. If you intend to study Further Maths, in addition you need to complete the **Year 12 AS/A Level Further Maths Baseline Test** at the back of the booklet and bring this with you to the first lesson.

# **Summer Work**

These exercises give you the opportunity to practice the skills that will be required to start A Level Mathematics successfully and identify any areas where you may need to spend additional time.

Worked solutions are available for you to check your answers.

Remember that additional help is available from:

- your revision guide
- [www.hegartymaths.com](http://www.hegartymaths.com)
- [www.corbettmaths.com](http://www.corbettmaths.com)
- [www.mathsgenie.co.uk](http://www.mathsgenie.co.uk) ....and many other websites

You have done well in your GCSE mathematics course so we have high expectations of your algebra and number skills. Now, as an A level student, we have very high expectations for the effort you will put into the course, only through an excellent attitude to learning and work ethic can students succeed in A level maths; use this summer work as an example of the effort you plan to put into the course.

## **Contents:**

- Indices
- Surds
- Expanding and Factorising Single Brackets
- Solving Linear Equations
- Rearranging Formulae
- Solving Linear Simultaneous Equations
- Expanding and Factorising Double Brackets
- The Quadratic Formula
- Completing the Square
- Solving Nonlinear Simultaneous Equations
- Expanding Triple Brackets

## Laws of Indices

1. (a) Simplify  $m^5 \div m^3$  (b) Simplify  $5x^4y^3 \times x^2y$
2. Write down the value of  $125^{\frac{2}{3}}$
3. (a) Write down the value of  $10^{-1}$  (b) Find the value of  $216^{\frac{2}{3}}$
4. (a) Find the value of  $5^0$  (b) Find the value of  $27^{\frac{1}{3}}$   
(c) Find the value of  $2^{-3}$
5. (a) Write down the value of  $27^{\frac{1}{3}}$  (b) Find the value of  $25^{-\frac{1}{2}}$
6. (a) Write down the value of  $64^{\frac{1}{2}}$  (b) Find the value of  $\left(\frac{8}{125}\right)^{\frac{2}{3}}$

## Surds

1. Work out

$$\frac{(5 + \sqrt{3})(5 - \sqrt{3})}{\sqrt{22}}$$

Give your answer in its simplest form.

2. (a) Rationalise the denominator of  $\frac{1}{\sqrt{3}}$   
(b) Expand  $(2 + \sqrt{3})(1 + \sqrt{3})$   
Give your answer in the form  $a + b\sqrt{3}$  where  $a$  and  $b$  are integers.
3. (a) Rationalise the denominator of  $\frac{1}{\sqrt{7}}$   
(b) (i) Expand and simplify  $(\sqrt{3} + \sqrt{15})^2$   
Give your answer in the form  $a + b\sqrt{3}$  where  $a$  and  $b$  are integers.

- (ii) All measurements on the triangle are in centimetres.  
 $ABC$  is a right-angled triangle.  
 $k$  is a positive integer.

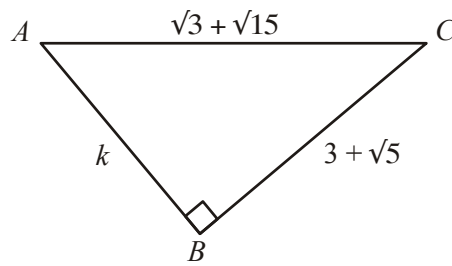


Diagram **NOT**  
 accurately drawn

Find the value of  $k$ .

4. Expand and simplify  $(\sqrt{3} - \sqrt{2})(\sqrt{3} - \sqrt{2})$
5. Write  $\frac{\sqrt{18} + 10}{\sqrt{2}}$  in the form  $a + b\sqrt{2}$  where  $a$  and  $b$  are integers.
6. Expand and simplify  $(2 + \sqrt{3})(7 - \sqrt{3})$   
 Give your answer in the form  $a + b\sqrt{3}$  where  $a$  and  $b$  are integers.
7. Rationalise the denominator of  $\frac{(4 + \sqrt{2})(4 - \sqrt{2})}{\sqrt{7}}$   
 Give your answer in its simplest form.
8. Show that  $\frac{(4 - \sqrt{3})(4 + \sqrt{3})}{\sqrt{13}}$  simplifies to  $\sqrt{13}$

### Expanding and Factorising (Single Brackets)

1. (a) Expand  $5(m + 2)$                       (b) Factorise  $y^2 + 3y$   
       (c) Simplify  $a^5 \times a^4$
2. (a) Expand  $2m(m + 3)$                       (b) Factorise fully  $3xy^2 - 6xy$
3. (a) Expand  $3(x + 4)$                           (b) Expand  $x(x^2 + 2)$   
       (c) Factorise  $x^2 - 6x$

4. (a) Expand and simplify  $5(x + 7) + 3(x - 2)$

(b) Factorise completely  $3a^2b + 6ab^2$

5. (a) Expand  $3(2y - 5)$

(b) Factorise completely  $8x^2 + 4xy$

6. (a) Factorise  $3x + 6$

(b) Expand and simplify  $5(y - 2) + 2(y - 3)$

7. (a) Factorise  $4x + 10y$

(b) Factorise  $x^2 + 7x$

### Solving Equations

1. Solve  $4x + 3 = 19$

2. (a) Solve  $6x - 7 = 38$

(b) Solve  $4(5y - 2) = 40$

3. Solve  $5(2y + 3) = 20$

4. (a) Solve  $7x + 18 = 74$

(b) Solve  $4(2y - 5) = 32$

(c) Solve  $5p + 7 = 3(4 - p)$

5. (a) Solve  $7p + 2 = 5p + 8$

(b) Solve  $7r + 2 = 5(r - 4)$

6. Solve  $4y + 1 = 2y + 8$

## Rearranging Formulae

1. Make  $u$  the subject of the formula  $D = ut + kt^2$
2. (a) Solve  $4(x + 3) = 6$   
(b) Make  $t$  the subject of the formula  $v = u + 5t$
3. (a) Expand and simplify  $(x - y)^2$   
(b) Rearrange  $a(q - c) = d$  to make  $q$  the subject.
4. Make  $x$  the subject of  $5(x - 3) = y(4 - 3x)$
5. Rearrange the formula to make  $a$  the subject.  $P = \frac{n^2 + a}{n + a}$
6. Make  $x$  the subject of the formula.  $\frac{x}{x + c} = \frac{p}{q}$

## Linear Simultaneous Equations

1. The Singh family and the Peterson family go to the cinema.  
The Singh family buy 2 adult tickets and 3 child tickets.  
They pay £28.20 for the tickets.  
The Peterson family buy 3 adult tickets and 5 child tickets.  
They pay £44.75 for the tickets.  
Find the cost of each adult ticket and each child ticket.
2. Solve the simultaneous equations
$$\begin{aligned} 3x + 4y &= 5 \\ 2x - 3y &= 9 \end{aligned}$$
3. Solve the simultaneous equations
$$\begin{aligned} 4x + 7y &= 1 \\ 3x + 10y &= 15 \end{aligned}$$
4. Solve the simultaneous equations
$$\begin{aligned} 4x + y &= 25 \\ x - 3y &= 16 \end{aligned}$$

5. Solve the simultaneous equations

$$\begin{aligned}3x - 2y &= 7 \\ 7x + 2y &= 13\end{aligned}$$

6. A cinema sells adult tickets and child tickets.  
The total cost of 3 adult tickets and 1 child ticket is £30  
The total cost of 1 adult ticket and 3 child tickets is £22  
Work out the cost of an adult ticket and the cost of a child ticket.
7. Paper clips are sold in small boxes and in large boxes.  
There is a total of 1115 paper clips in 4 small boxes and 5 large boxes.  
There is a total of 530 paper clips in 3 small boxes and 2 large boxes.  
Work out the number of paper clips in each small box and in each large box.

### **Expand and Factorise Quadratics**

1. Expand and simplify  $(m + 7)(m + 3)$
2. (a) Factorise  $6 + 9x$   
(b) Factorise  $y^2 - 16$   
(c) Factorise  $2p^2 - p - 10$
3. Solve, by factorising, the equation  $8x^2 - 30x - 27 = 0$
4. Factorise  $x^2 + 3x - 4$
5. Write  $x^2 + 2x - 8$  in the form  $(x + m)^2 + n$  where  $m$  and  $n$  are integers.
6. (a) Expand  $4(3x + 5)$   
(b) Expand and simplify  $2(x - 4) + 3(x + 5)$   
(c) Expand and simplify  $(x + 4)(x + 6)$
7. (a) Factorise  $x^2 + 5x + 4$   
(b) Expand and simplify  $(3x - 1)(2x + 5)$



8. (a) Expand  $3(2 + t)$  (b) Expand  $3x(2x + 5)$   
(c) Expand and simplify  $(m + 3)(m + 10)$
9. (a) Factorise  $x^2 + 7x$   
(b) Factorise  $y^2 - 10y + 16$   
(c) (i) Factorise  $2t^2 + 5t + 2$   
(ii)  $t$  is a positive whole number.  
The expression  $2t^2 + 5t + 2$  can never have a value that is a prime number.  
Explain why.

### Using the Quadratic Formula

1. Solve  $3x^2 + 7x - 13 = 0$ .  
Give your solutions correct to 2 decimal places.
2. Solve the equation  
 $2x^2 + 6x - 95 = 0$   
Give your solutions correct to 3 significant figures.
3. Solve  $x^2 + 3x - 5 = 0$   
Give your solutions correct to 4 significant figures.
4. Solve this quadratic equation.  
 $x^2 - 5x - 8 = 0$   
Give your answers correct to 3 significant figures.
5. (a) Solve  $x^2 - 2x - 1 = 0$   
Give your solutions correct to 2 decimal places.  
(b) Write down the solutions, correct to 2 decimal places, of  $3x^2 - 6x - 3 = 0$

6. (a) Solve  $x^2 + x + 11 = 14$   
Give your solutions correct to 3 significant figures.

(b)  $y = x^2 + x + 11$

The value of  $y$  is a prime number when  $x = 0, 1, 2$  and  $3$   
The following statement is not true.

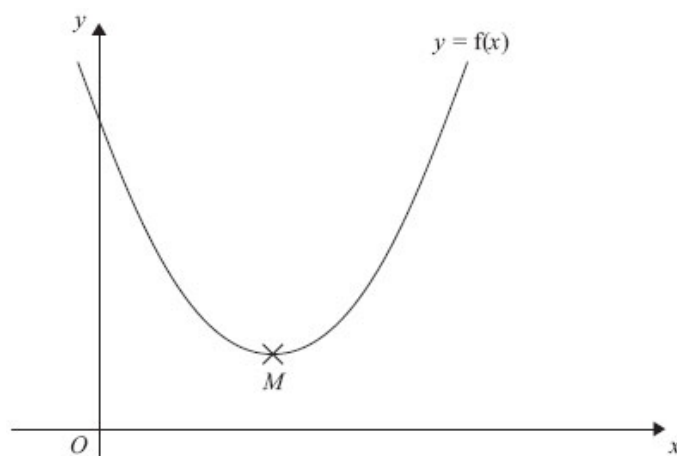
' $y = x^2 + x + 11$  is always a prime number when  $x$  is an integer'

Show that the statement is not true.

### Completing the Square

1. (i) Sketch the graph of  $f(x) = x^2 - 5x + 10$ , showing the coordinates of the turning point and the coordinates of any intercepts with the coordinate axes.
- (ii) Hence, or otherwise, determine whether  $f(x + 2) - 3 = 0$  has any real roots.  
Give reasons for your answer.
2. (a) Write  $2x^2 + 16x + 35$  in the form  $a(x + b)^2 + c$  where  $a, b$ , and  $c$  are integers.
- (b) Hence, or otherwise, write down the coordinates of the turning point of the graph of  $y = 2x^2 + 16x + 35$
3. The expression  $x^2 - 8x + 21$  can be written in the form  $(x - a)^2 + b$  for all values of  $x$ .
- (a) Find the value of  $a$  and the value of  $b$ .

The equation of a curve is  $y = f(x)$  where  $f(x) = x^2 - 8x + 21$   
The diagram shows part of a sketch of the graph of  $y = f(x)$ .



The minimum point of the curve is  $M$ .

- (b) Write down the coordinates of  $M$ .

## **Nonlinear Simultaneous Equations**

1. Solve the equations

$$\begin{aligned}x^2 + y^2 &= 36 \\ x &= 2y + 6\end{aligned}$$

2. Solve the simultaneous equations

$$\begin{aligned}x^2 + y^2 &= 25 \\ y &= 2x + 5\end{aligned}$$

3. Solve the simultaneous equations

$$\begin{aligned}x^2 + y^2 &= 9 \\ x + y &= 2\end{aligned}$$

Give your answers correct to 2 decimal places.

4. Solve algebraically the simultaneous equations

$$\begin{aligned}x^2 + y^2 &= 25 \\ y - 2x &= 5\end{aligned}$$

## **Expanding Three Brackets**

1. Show that

$$(x - 1)(x + 2)(x - 4) = x^3 - 3x^2 - 6x + 8$$

for all values of  $x$ .

2. Show that

$$(3x - 1)(x + 5)(4x - 3) = 12x^3 + 47x^2 - 62x + 15$$

for all values of  $x$ .

3. Show that

$$(x - 3)(2x + 1)(x + 3) = 2x^3 + x^2 - 18x - 9$$

for all values of  $x$ .

4.  $(2x + 1)(x + 6)(x - 4) = 2x^3 + ax^2 + bx - 24$

for all values of  $x$ , where  $a$  and  $b$  are integers. Calculate the values of  $a$  and  $b$ .

# Year 12 AS/A level Maths Baseline Test

## Instructions

- The time for the test is 1 hour.
- Answer **all** questions.

## Information

- The total mark for this paper is 48.
- The marks for each question are shown in brackets  
*-use this as a guide as to how much time to spend on each question.*

## Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

1 Simplify these expressions.

a  $\frac{x^3 \times x^4}{x^2}$  (1 mark)

b  $(2x^3)^4$  (1 mark)

c  $\frac{9x^{\frac{1}{2}}}{(27x^{-2})^{\frac{2}{3}}}$  (3 marks)

2 Solve  $2x^2 \times 4x^4 = 512$  (2 marks)

3 Find the value of  $x$ .

$$x^{-\frac{4}{3}} = \frac{1}{256} \quad (2 \text{ marks})$$

4 a Write  $\sqrt{240}$  in the form  $a\sqrt{15}$ , where  $a$  is an integer. (1 mark)

b Expand and simplify  $(2 - \sqrt{3})(5 + 2\sqrt{3})$ . (2 marks)

c Simplify  $\frac{2 + \sqrt{5}}{3 - \sqrt{5}}$  giving your answer in the form  $a + b\sqrt{c}$ , where  $a$ ,  $b$  and  $c$  are rational numbers. (3 marks)

- 5** The area of a triangle is given as  $(7 + 3\sqrt{3}) \text{ cm}^2$ .

The base of the triangle is  $(5 - \sqrt{3}) \text{ cm}$ , and the perpendicular height is  $(p + q\sqrt{3}) \text{ cm}$ .

Find the values of  $p$  and  $q$ .

**(4 marks)**

- 6** Expand and simplify these expressions.

**a**  $3(x - 2y)$

**(1 mark)**

**b**  $(2x - 3)(3x + 5)$

**(2 marks)**

**c**  $(x - 2)^2(x + 5)$

**(3 marks)**

- 7** Fully factorise these expressions.

**a**  $2xy - 4x$

**(1 mark)**

**b**  $x^2 + 2x - 3$

**(1 mark)**

- 8** Solve these equations.

**a**  $3x - 7 = 17$

**(1 mark)**

**b**  $x^2 - 6x + 5 = 0$

**(2 marks)**

**c**  $2x^2 - 5x + 1 = 0$

**(2 marks)**

- 9** Solve these pairs of simultaneous equations.

**a**  $2x + y = 7$

**(3 marks)**

$3x - y = 8$

**b**  $y = 3x - 1$

**(3 marks)**

$3y = 6x + 1$

**c**  $2x - y = 9$

**(4 marks)**

$x^2 + y^2 = 17$

- 10** Solve these inequalities.

**a**  $7x - 6 \leq 8$

**(1 mark)**

**b**  $3x + 2 \geq 7x - 4$

**(2 marks)**

**c**  $x^2 + 12x - 28 > 0$

**(2 marks)**

- 11** The function  $f$  is defined as  $f(x) = 5x + 2$

Find the value of  $f(-4)$ .

**(1 mark)**

# Year 12 AS/A level Further Maths

## Baseline Test

### Instructions

- The time for the test is 1 hour.
- Answer **all** questions.

### Information

- The total mark for this paper is 48.
- The marks for each question are shown in brackets  
*-use this as a guide as to how much time to spend on each question.*

### Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

1 Simplify these expressions as far as possible.

a  $\frac{x^2 - 2x - 3}{x^2 + 2x + 1}$  (3 marks)

b  $\frac{x^2 - 25}{x^2 + 6x + 8} \div \frac{x^2 - 2x - 15}{x^2 - 16}$  (4 marks)

2 The line  $l$  is a tangent to the circle  $x^2 + y^2 = 20$  at the point  $P(2, 4)$ .

The tangent intersects the  $y$ -axis at point  $A$ . Find the area of the triangle  $OPA$ . (5 marks)

3 Expand and simplify  $(\sqrt{p} + 2\sqrt{q})(2\sqrt{p} - \sqrt{q})$  (3 marks)

4 a Write  $3x^2 - 12x + 7$  in the form  $a(x+b)^2 + c$  (3 marks)

b Hence, or otherwise, write down the coordinates of the turning point of the graph of  $y = 3x^2 - 12x + 7$  (1 mark)

5 Prove algebraically that the product of three consecutive **odd** numbers is always an odd number. (4 marks)

- 6 The functions  $g$  and  $f$  are defined as  $g(x) = \frac{2x}{4-x}$  and  $f(x) = 3x - 1$

Given that  $x \neq 4$ , find the value(s) of  $x$  such that  $g(x) = f(x)$ , giving your answer(s) to 2 decimal places.

**(6 marks)**

- 7 The line  $l_1$  has equation  $y = -\frac{1}{2}x + 3$  and intersects the  $x$ - and  $y$ -axes at the points  $A$  and  $B$  respectively.

**a** Find the exact length of the line segment  $AB$ .

**(3 marks)**

**b** Find the equation of the line  $l_2$  perpendicular to  $l_1$  which passes through the point  $P(-1, -2)$ .

**(2 marks)**

The line  $l_2$  intersects  $l_1$  at the point  $C$ .

**c** Find the midpoint of the line segment  $AC$ .

**(4 marks)**

- 8 A triangle  $ABC$  has side lengths  $AB = 10$  cm,  $BC = 15$  cm and  $AC = 8$  cm.

**a** Find the size of the largest angle, giving your answer to 2 decimal places.

**(3 marks)**

**b** Find the area of the triangle, giving your answer to 2 decimal places.

**(2 marks)**

- 9 **a** Sketch the graph of  $y = \cos x$  for  $-180 \leq x \leq 360^\circ$ , showing the points where the graph cuts the axes.

**(2 marks)**

**b** Hence find the exact values of  $x$  in the interval  $-180 \leq x \leq 360^\circ$  for which

$$\cos x = -\frac{\sqrt{3}}{2}$$

**(3 marks)**